Space Weather Technical Forecast

Issued on Thursday, 19 January 2023 at 00:33 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further R1/R2 Radio Blackouts likely. Chance of G1/Minor Geomagnetic Storms through to day 3 (21 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with one M-class flare, peaking at M1.8 at 8/1035 UTC. This flare emanated from the largest and most complex region on the disc, AR3190 in the southeast. AR3192 in the northeast is also a large region, which contains a weak delta spot, with AR3190 also containing delta spots. The remaining six regions appear stable for now with some regions showing signs of fading. A new and unnumbered sunspot region has emerged around the northeast limb.
No new Earth-directed CMEs have been observed in available coronagraph imagery. There are numerous mostly small filaments on the disc at present, however the largest currently straddles the solar meridian near 30S and could give an Earth-directed CME should it this filament lift-off the Sun.

Solar Wind / Geomagnetic Activity: Solar wind speeds were slightly elevated through the period ending the period around 430 km/s. The density has been average or above average, with a peak of 25 ppcc around 18/0716 UTC. The IMF was moderate at around 15 nT but eased back to weak levels around 6 nT. The north-south component initially fell to -8 nT, before fluctuating between -6/+5 nT. The phi angle was predominately positive (away from the Sun). Geomagnetic activity was Active (Kp 4) between 18/0000 and 18/0600 UTC, thereafter it was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has been at Background levels throughout.
High energy electron flux (greater than 2 MeV) has been at background levels. The 24-hour integrated electron fluence stayed below the Active threshold on a fairly flat trend, reaching 6.44e6 integrated pfu at 18/2359 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be moderate, with a slight chance of reaching high levels. There are numerous regions on the disc, but the most obvious candidates for a significant flare are AR3190 and AR3192.

Solar Wind / Geomagnetic Activity: Solar wind speeds are slightly elevated around 430 km/s, however, a CME that was launched on 14 January may give a glancing blow early on Day 1 (19 Jan), wind speeds up to around 500 km/s possible. A further HSS from CH68 may connect with Earth during Day 2 (20 Jan) into day 3 (21 Jan), this could potentially increase solar wind speeds to around 600 km/s.
Geomagnetic activity is expected to be Quiet to Unsettled with Active intervals and a Chance of G1/Minor Storm intervals through to day 3 (21 Jan), lowering to a slight chance on day 4 (22 Jan) as CH HSS and possible CME effects start to wane.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is likely to remain at predominantly background levels, but with a slight chance of reaching S1 or greater through the period.
High energy electron flux remained at background levels over the past 24 hours. An increase is then possible later in the period. As such, electron fluence is likely to stay below the Active threshold for much of this period, but with an increasing trend into Day 4 (22 Jan).

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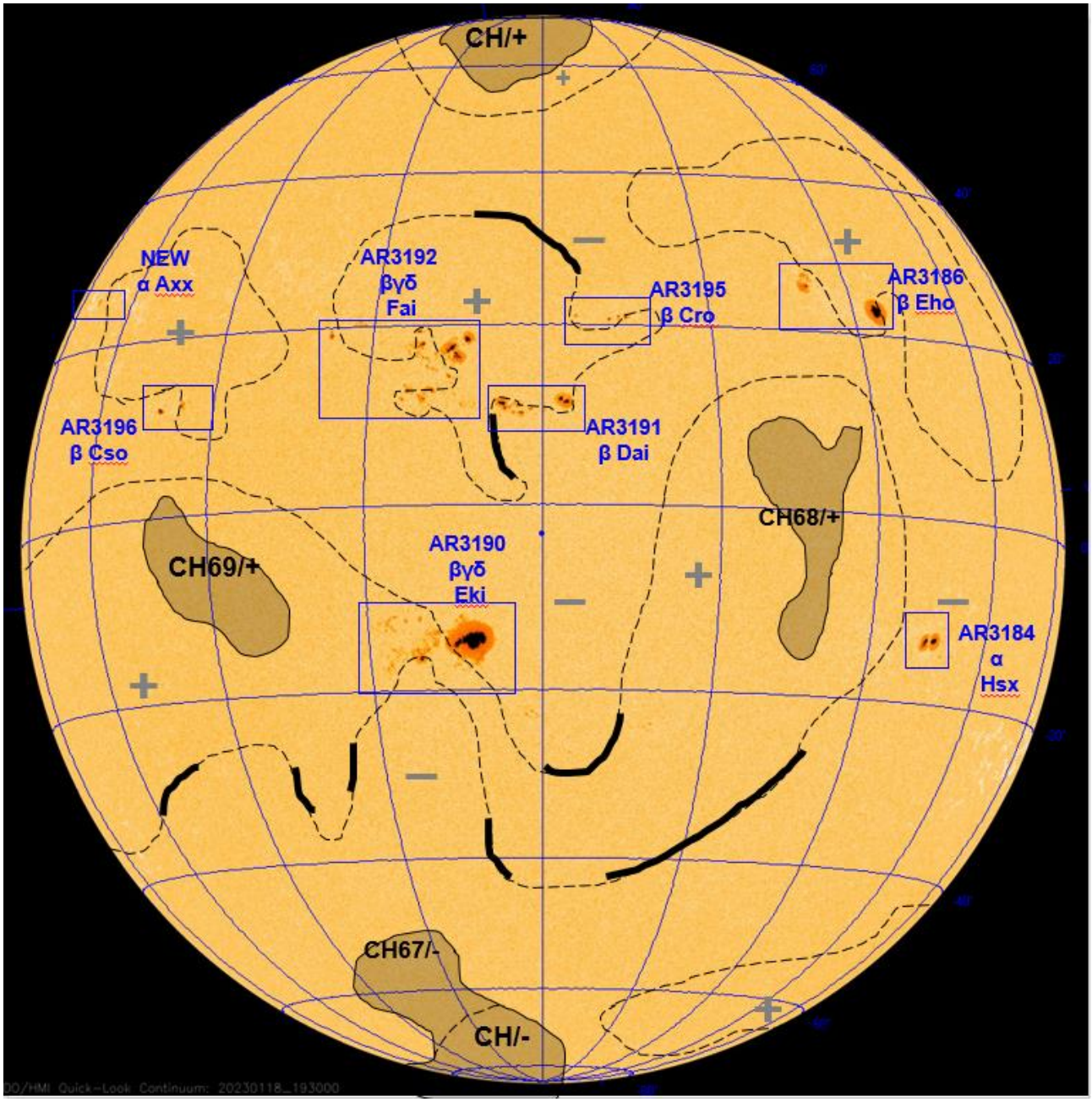
Figure 1. Solar Analysis Valid 18/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

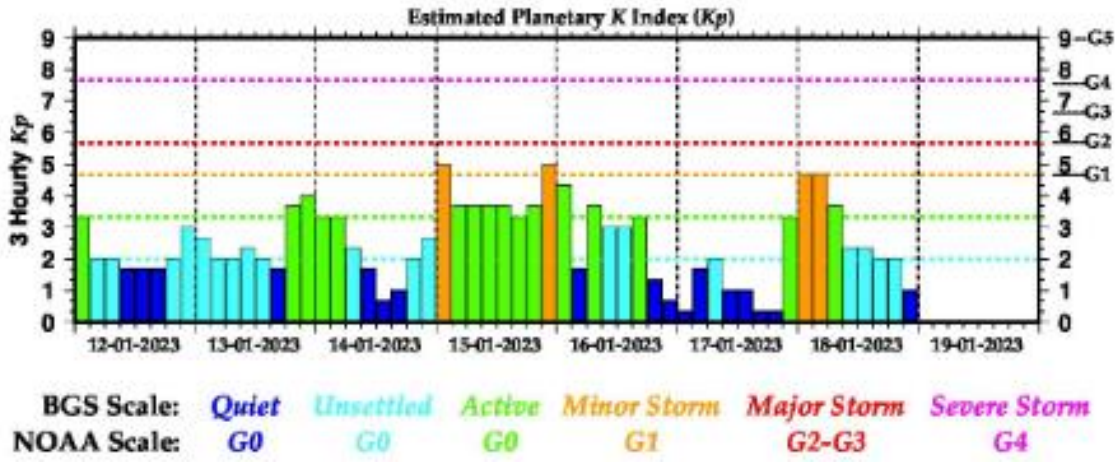
Solar wind speeds are slightly elevated around 430 km/s, however, a CME that was launched on 14 January may give a glancing blow early on Day 1 (19 Jan), wind speeds up to around 500 km/s possible. A further HSS from CH68 may connect with Earth during Day 2 (20 Jan) into day 3 (21 Jan), this could potentially increase solar wind speeds to around 600 km/s. Although this coronal hole appears to be a much weaker feature than the previous rotation.
Geomagnetic activity is expected to be Quiet to Unsettled with Active intervals and a Chance of G1/Minor Storm intervals through to day 3 (21 Jan), lowering to a slight chance on day 4 (22 Jan) as CH HSS and possible CME effects start to wane.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	40	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
15/0900	Partial	AR3182	SW	400km/s	19/0001UTC	Glancing blow possible

Figure 2: BGS Estimated Kp index



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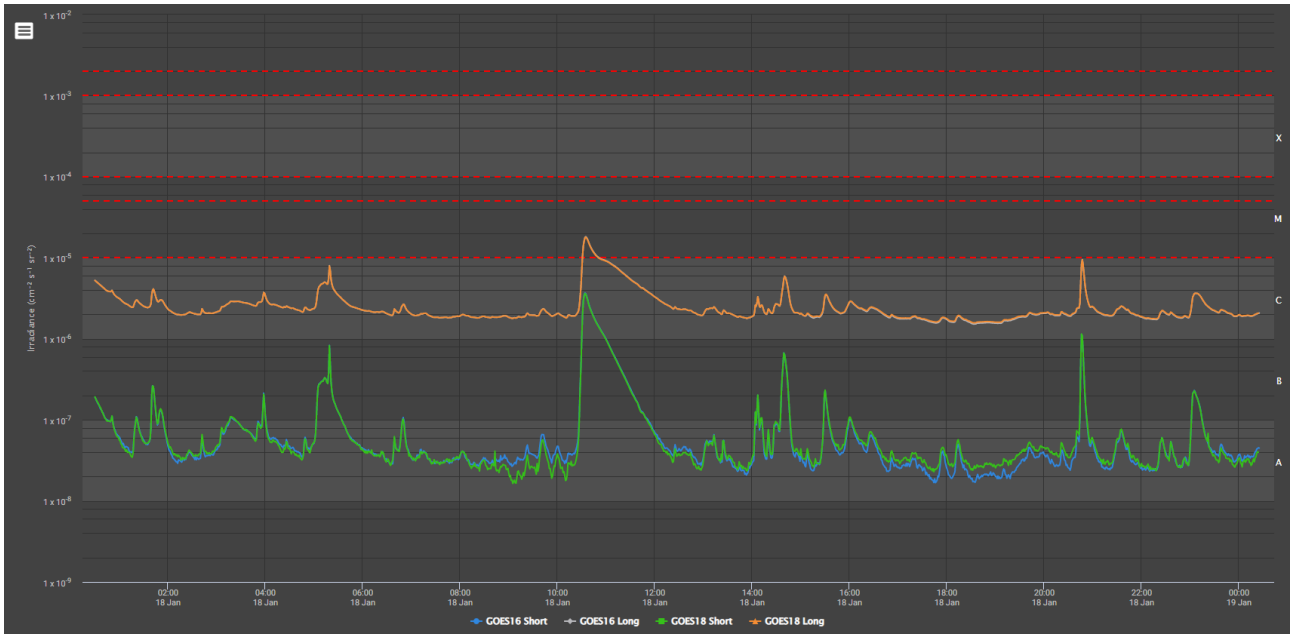
Radio Blackouts - X-Ray Flares:
Solar activity has been Moderate through the past 24 hours, with one M-class flare observed, peaking at M1.8 and emanating from AR3190 (Eki/Beta-Gamma-Delta), which is currently the largest and most magnetically complex on the disc with AR3192 (Fsi/Beta-Gamma-Delta). Both regions remain relatively large and complex regions as both have small and weak delta spots. The other regions on the visible disc at present appear largely stable, with some appearing to fade a little. A new and unnumbered region has rotated around the northeast limb, but appears to stable at present.
Far-side soundings suggest further regions may rotate onto the disc in the coming days, probably acting to maintain the risk of M-class flares through this period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3:GOES18 X-Ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux is currently at background levels.
While no recent S1+ events have been observed at GEO, the sheer number of both front and far-sided complex groups dictates an elevated risk. While the relative contribution to the risk will decrease through the coming days for Ex-3182, both AR3190 and AR3192 bring an increasing risk as they rotate westwards. As such, a slight chance of S1 or greater continues through this four day period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux has remained at background levels over the past 24 hours. The possibility of a glancing blow from a CME, is likely to continue the suppression through Day 1 (19 Jan) with a further HSS possible on Day 2 (20 Jan). An increase is then likely later in the period, probably on Day 4 (22 Jan), once the CME and HSS have begun to wane. It is difficult to judge the likelihood of significant electron charging occurring during this period until we see the strength of any HSS, however, so confidence in this is low.
As such, electron fluence is likely to stay below the Active threshold for much of this period, but with an increasing trend into Day 4. MOSWOC REFM is showing a level trend through the next 3 days, which is reasonable.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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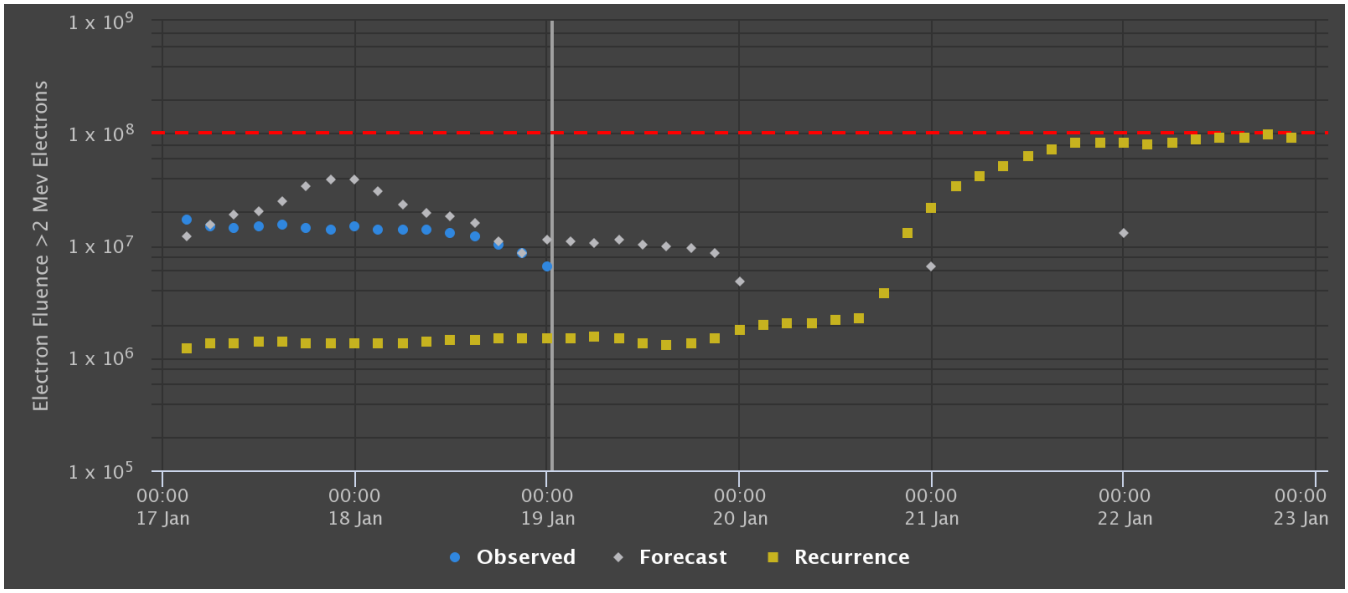
Figure 4: MOSWOC REF Model



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